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Ashibu

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(54) **CONNECTOR**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

H01R 13/62	(2006.01)
H01R 12/72	(2011.01)
H01R 13/629	(2006.01)
H01R 12/88	(2011.01)
H01R 12/77	(2011.01)

(52) **U.S. Cl.**
CPC ***H01R 12/721*** (2013.01); ***H01R 13/62977*** (2013.01); *H01R 12/774* (2013.01); *H01R 12/88* (2013.01)

(58) **Field of Classification Search**
CPC H01R 12/774; H01R 12/88
See application file for complete search history.

(56) **References Cited**

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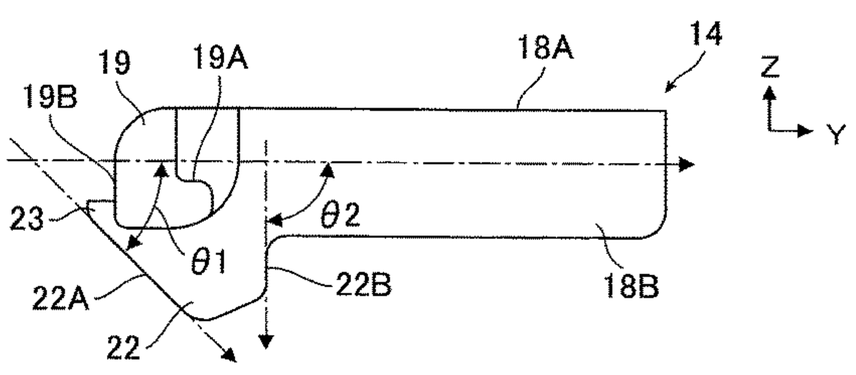
(57) **ABSTRACT**

A connector has a housing including an insertion portion, a recess-shaped shaft receiving portion opening in an opening direction and an abutment surface facing in an opposite direction from the opening direction, and an operation member held by the housing rotatably around an axis direction of a rotation shaft portion inserted in the shaft receiving portion, the operation member including a lock portion and a projection, as the operation member is brought to a closed position while a connection end portion of a connection target is inserted in the insertion portion, the lock portion is fitted in a lock receiving portion of the connection target to prohibit pull-out of the connection end portion of the connection target from the insertion portion, and the projection comes into contact with the abutment surface to prohibit movement of the operation member in the opening direction.

10 Claims, 8 Drawing Sheets



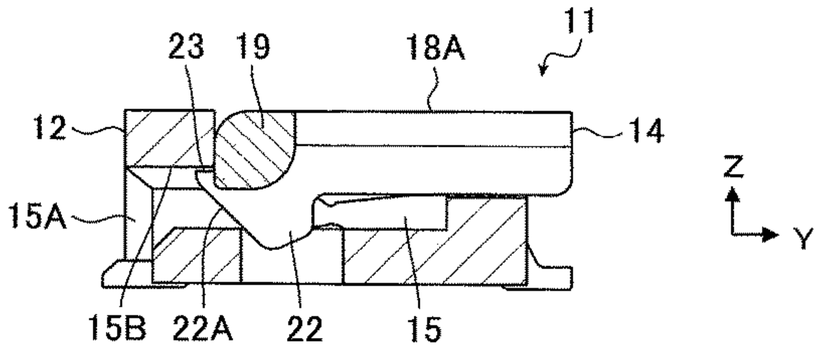


FIG. 1

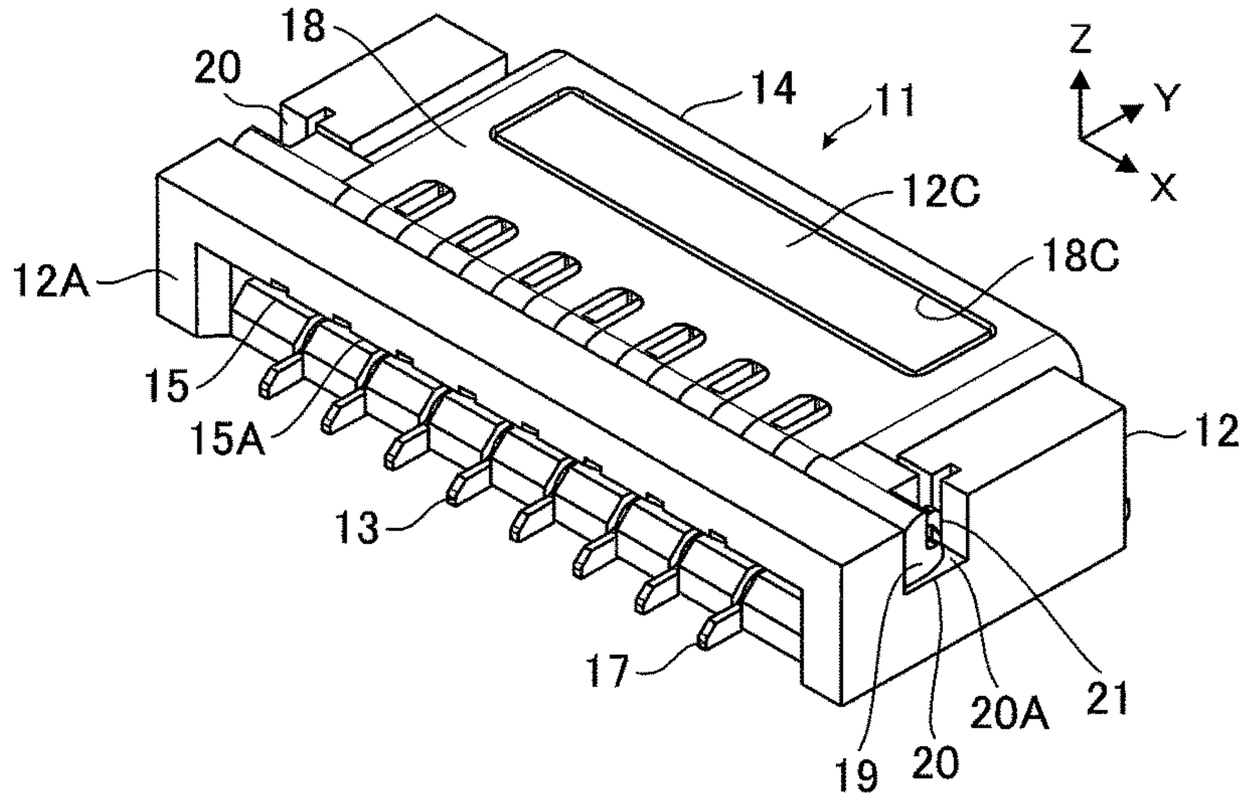


FIG. 2

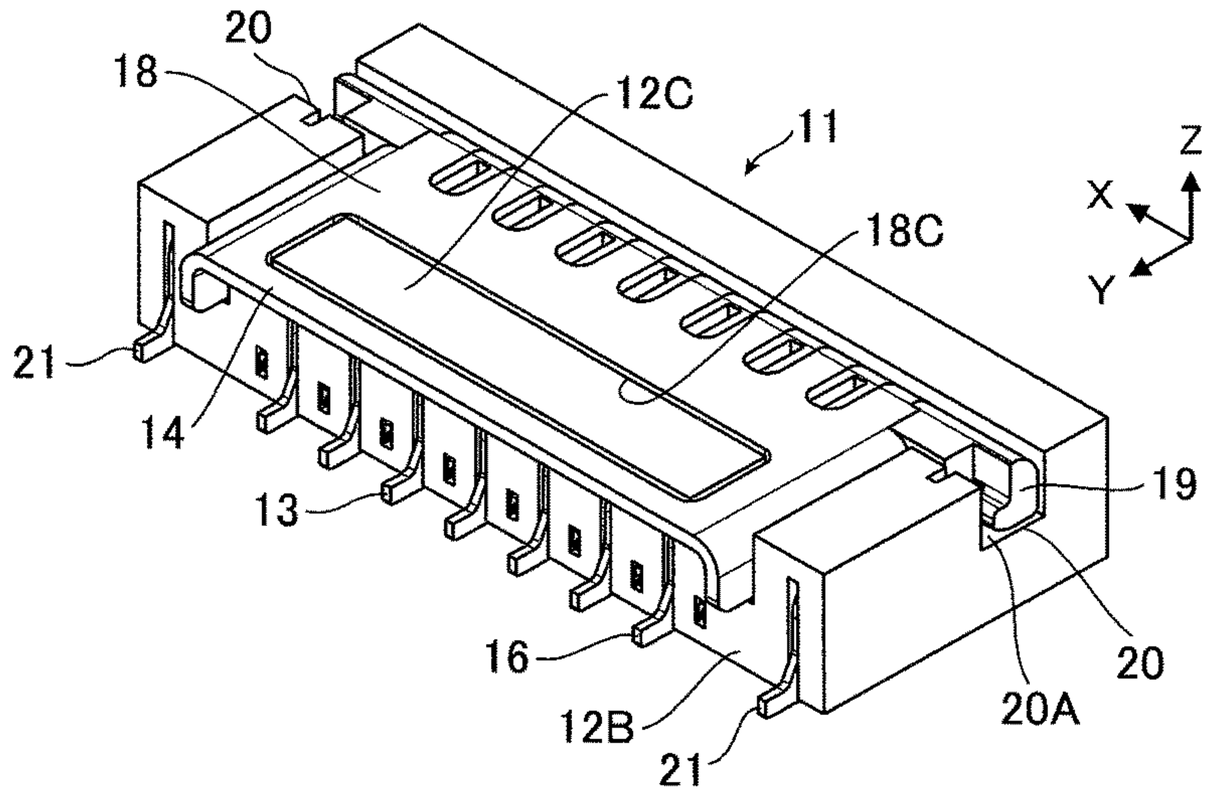


FIG. 3A

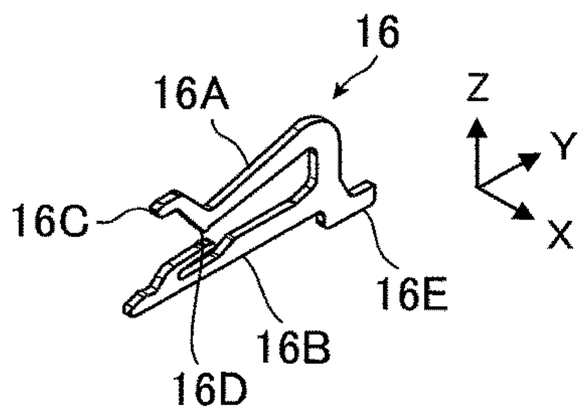


FIG. 3B

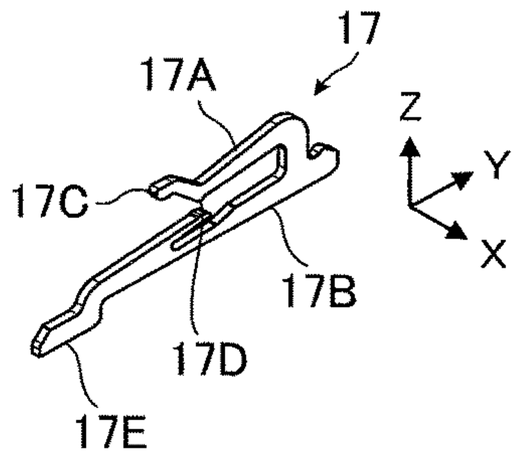


FIG. 4

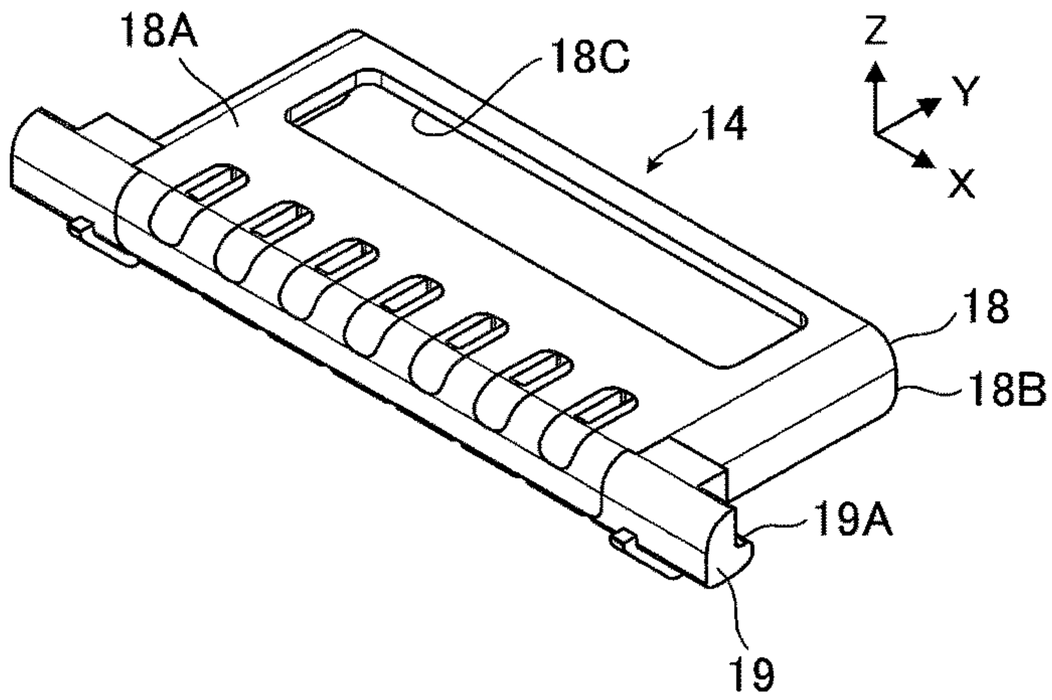


FIG. 5

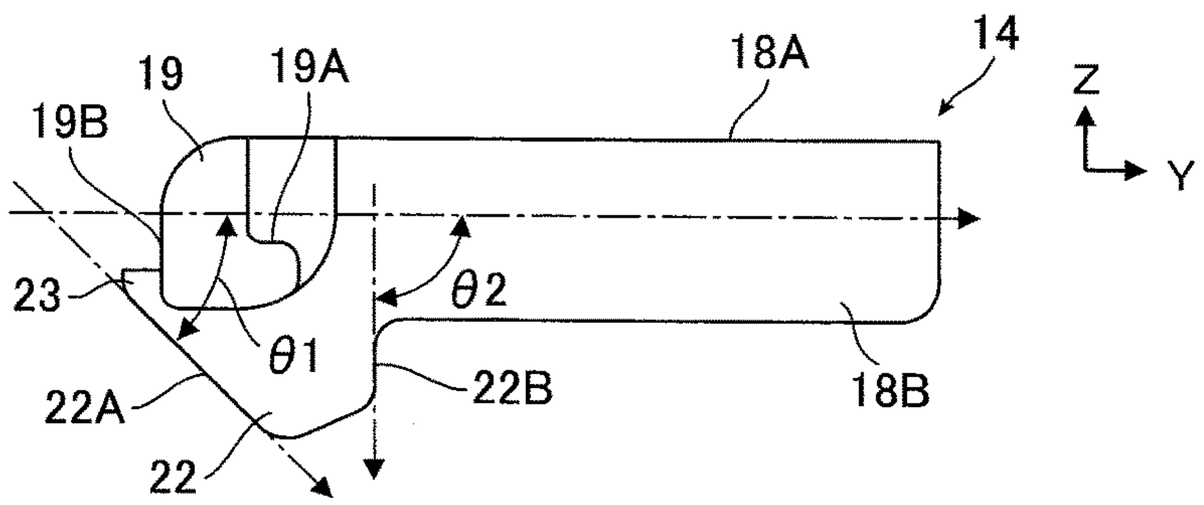


FIG. 6

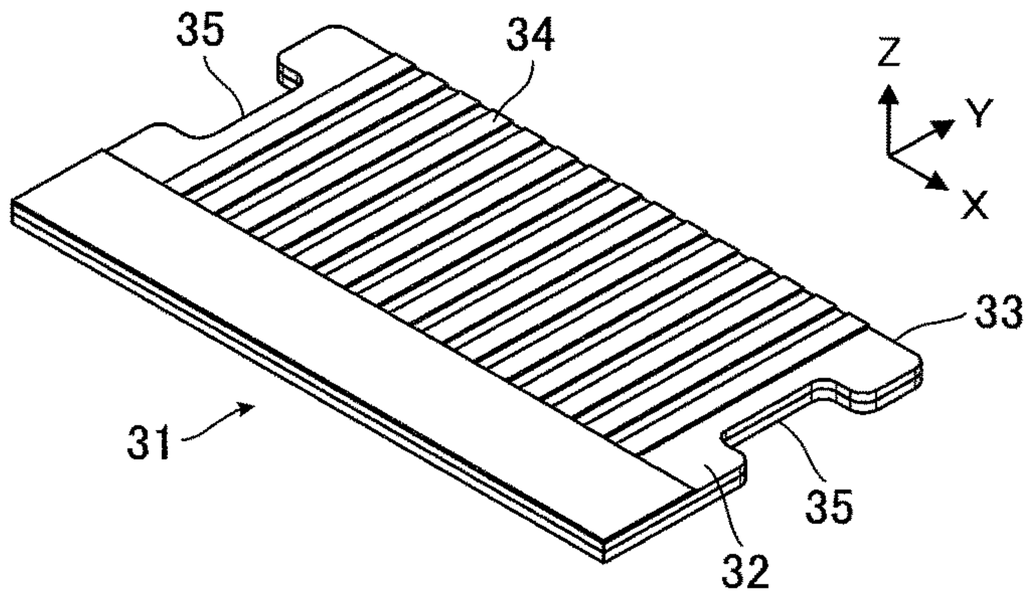


FIG. 7A

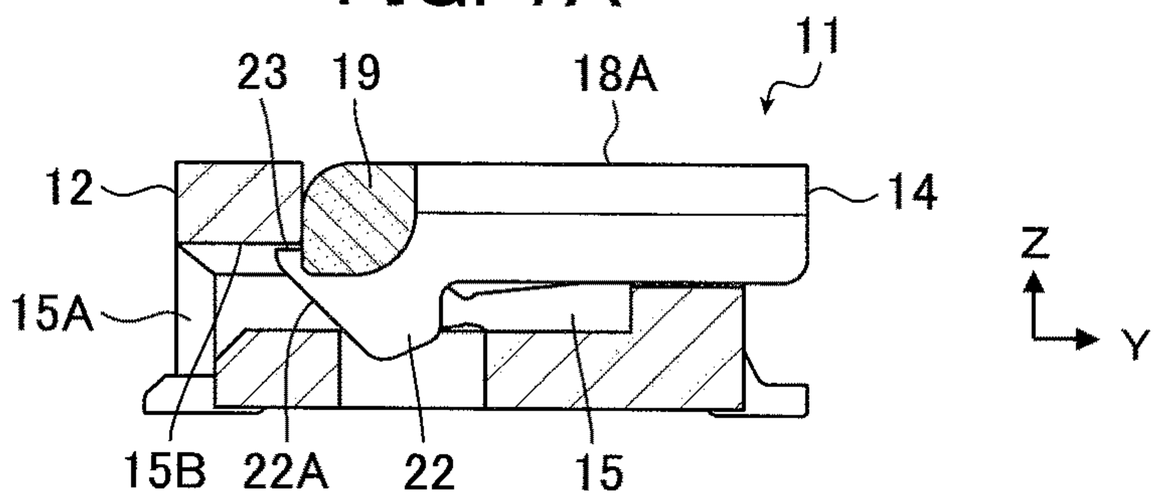


FIG. 7B

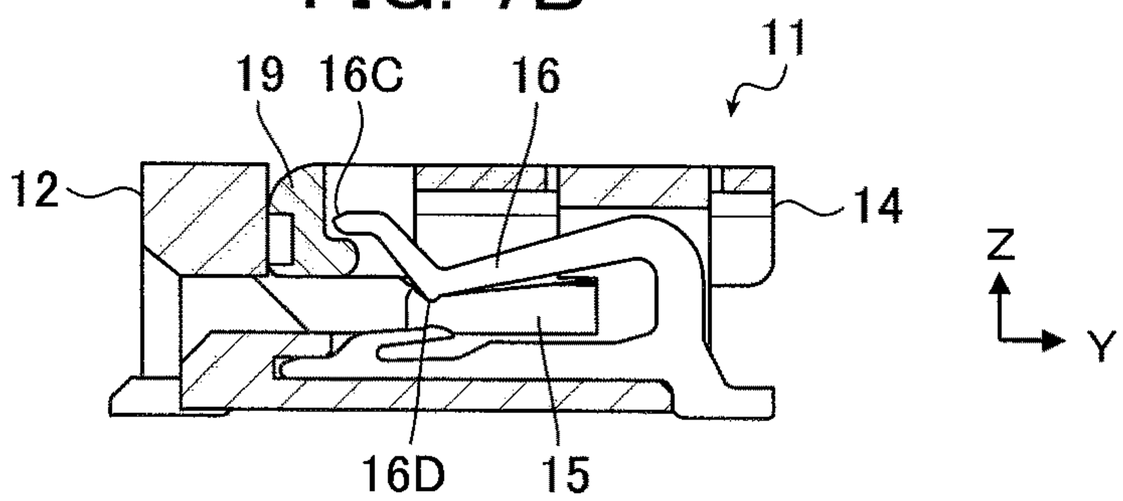


FIG. 7C

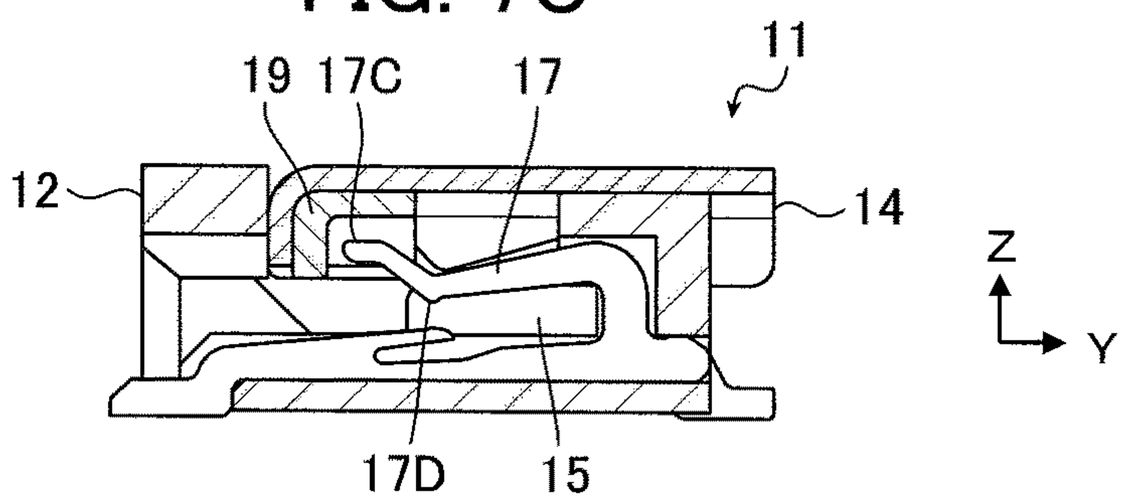


FIG. 7D

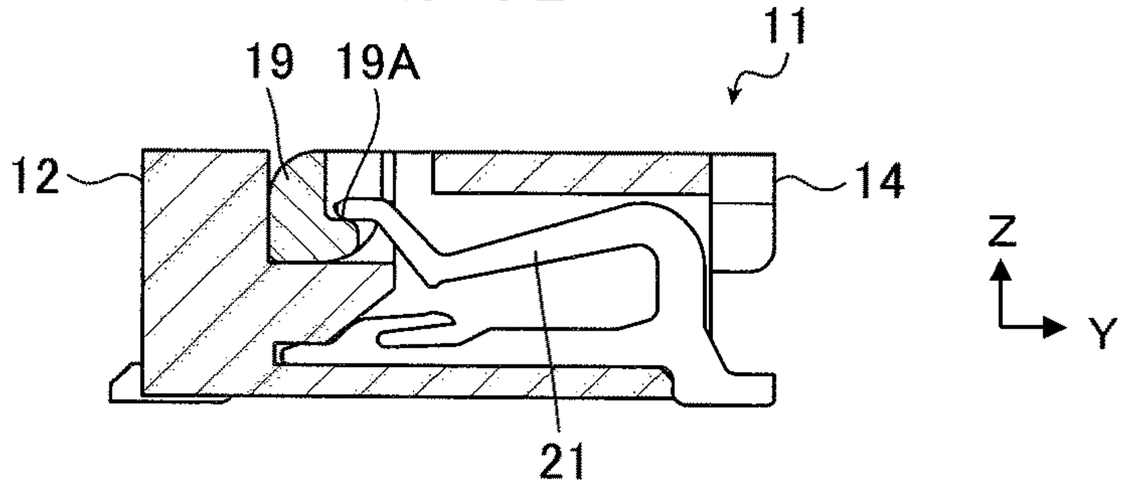


FIG. 8A

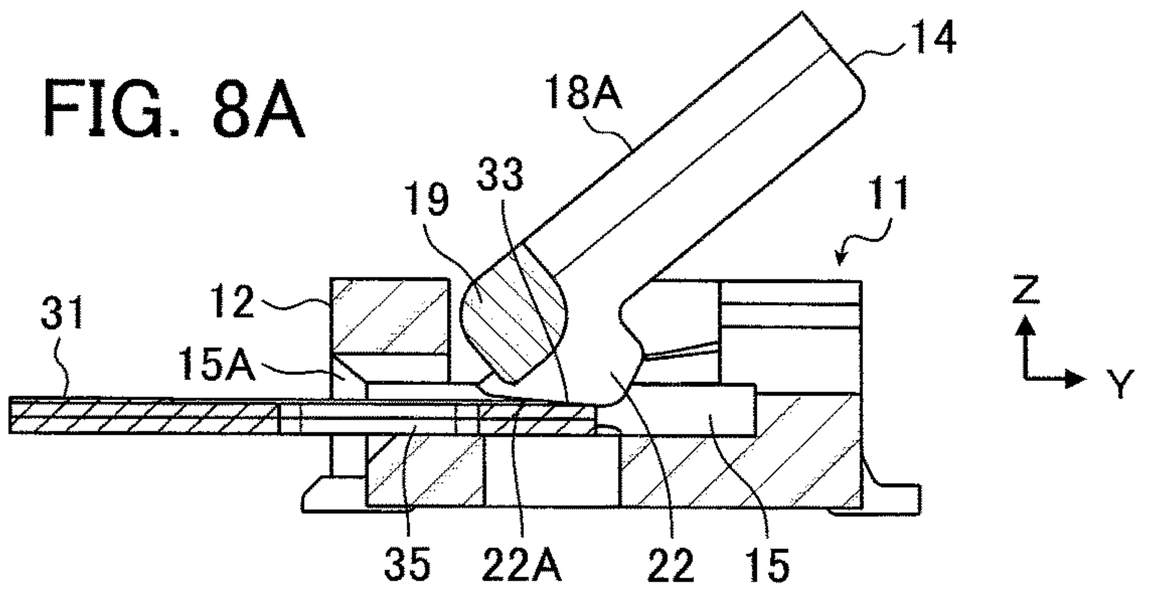


FIG. 8B

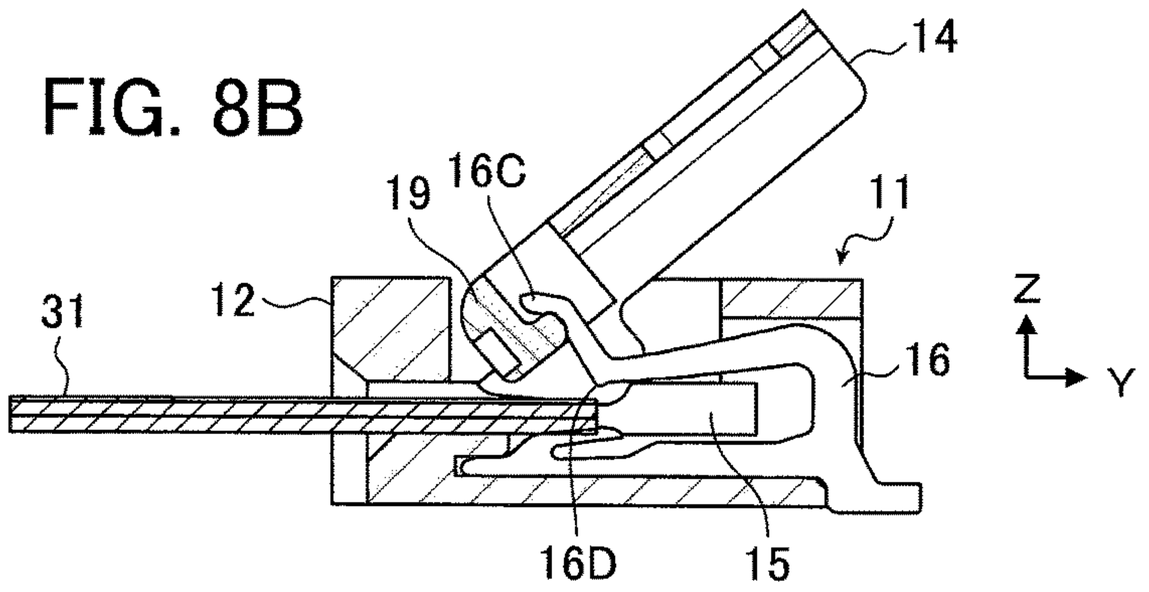


FIG. 8C

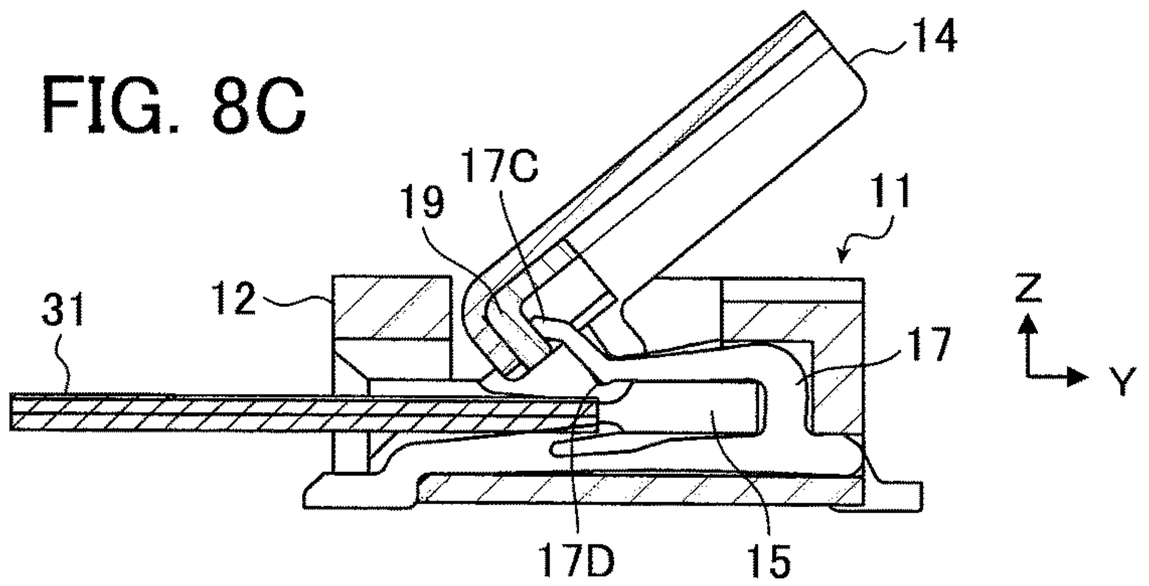


FIG. 8D

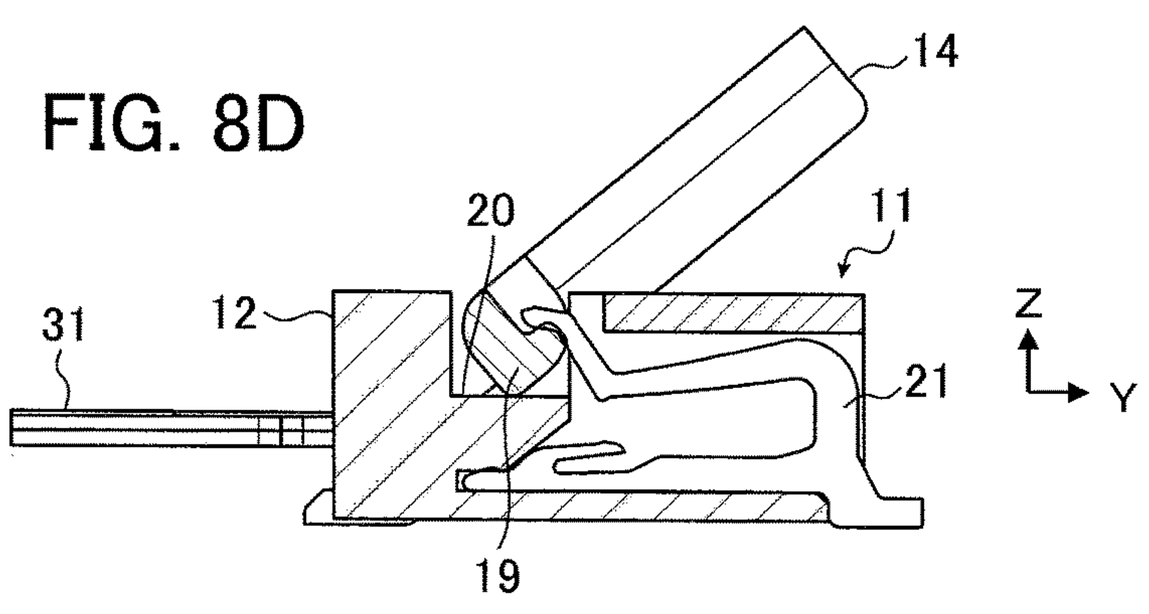


FIG. 9A

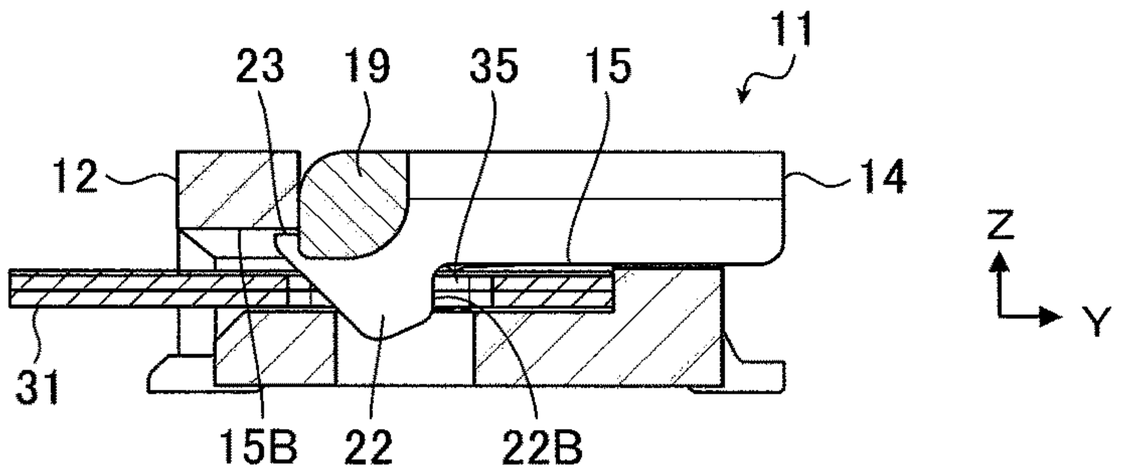


FIG. 9B

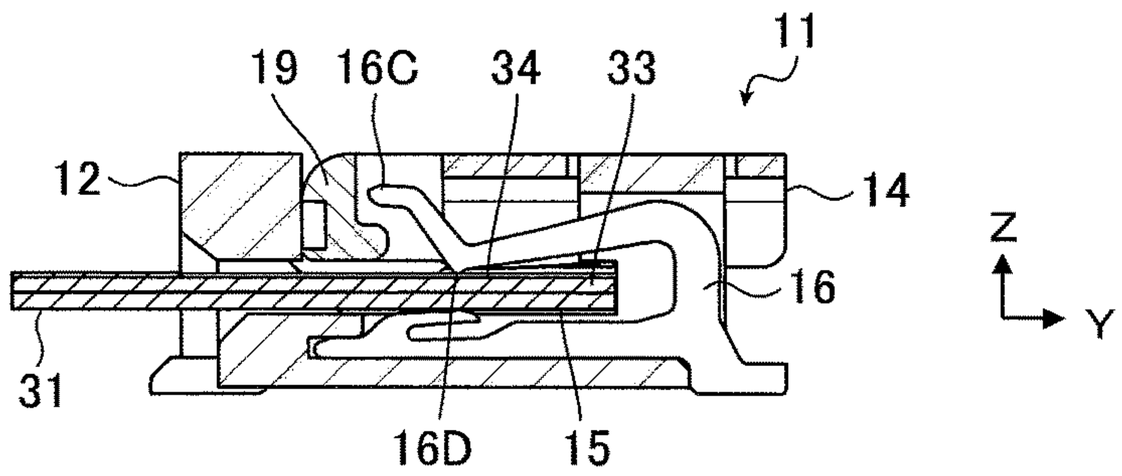


FIG. 9C

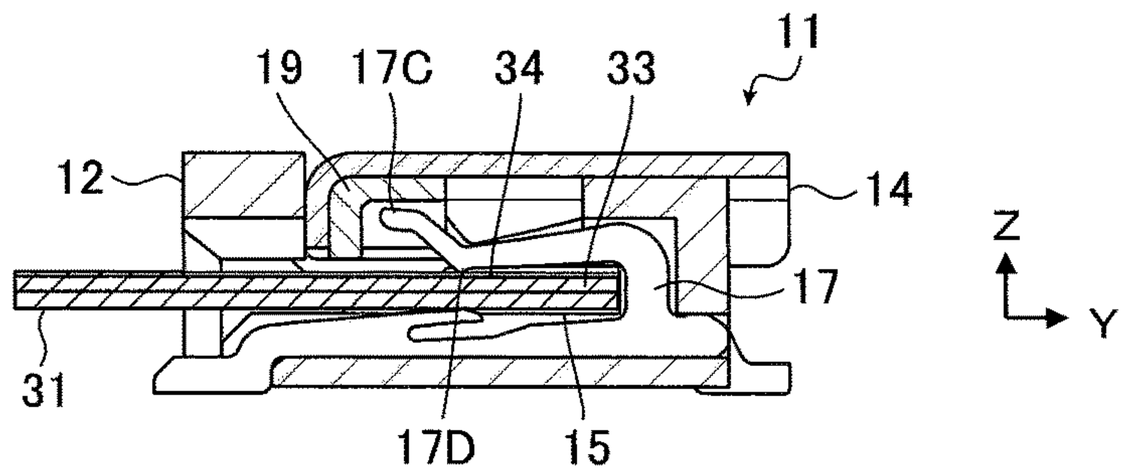


FIG. 9D

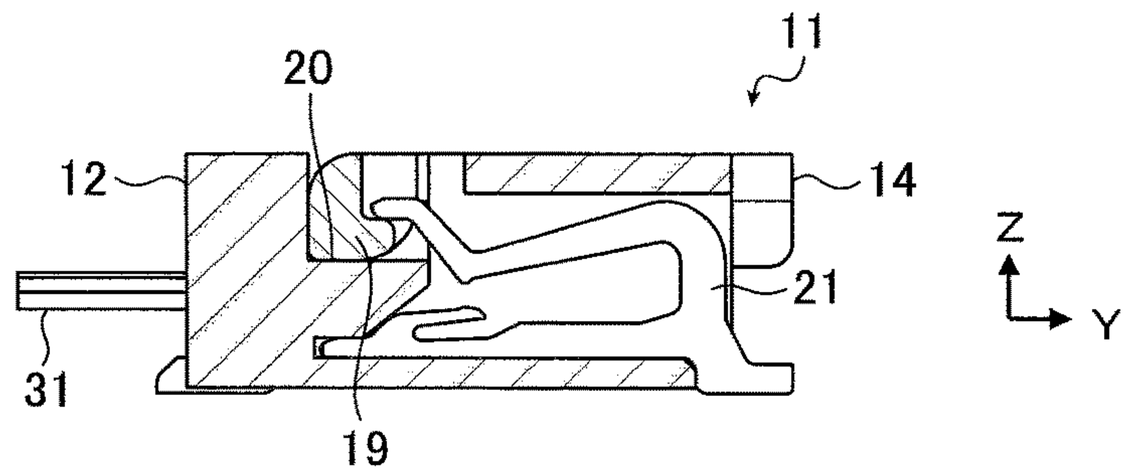


FIG. 10A

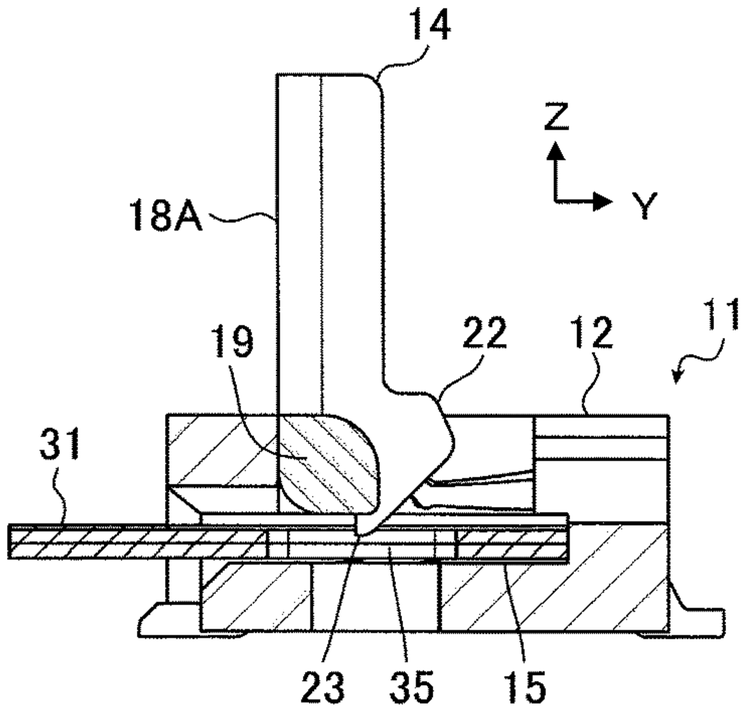
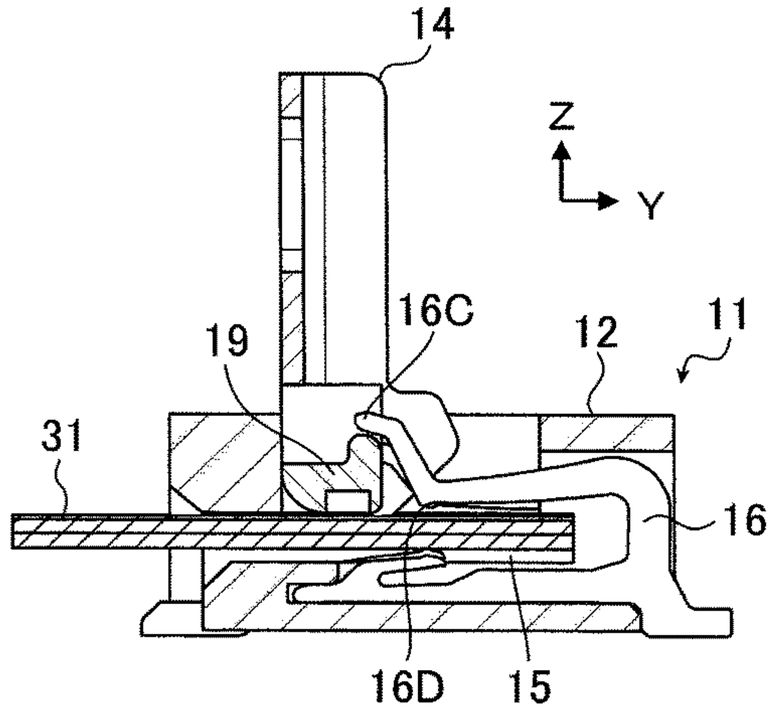


FIG. 10B



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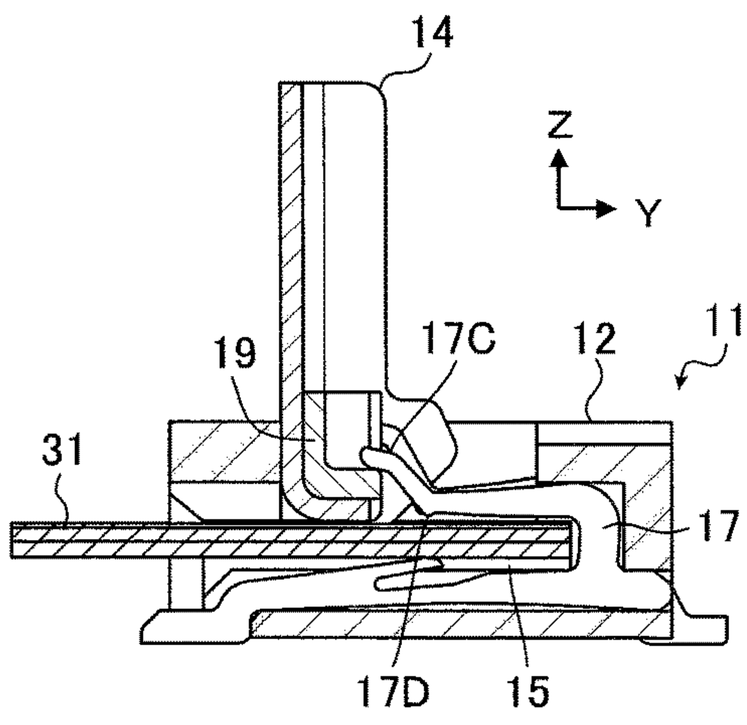


FIG. 10D

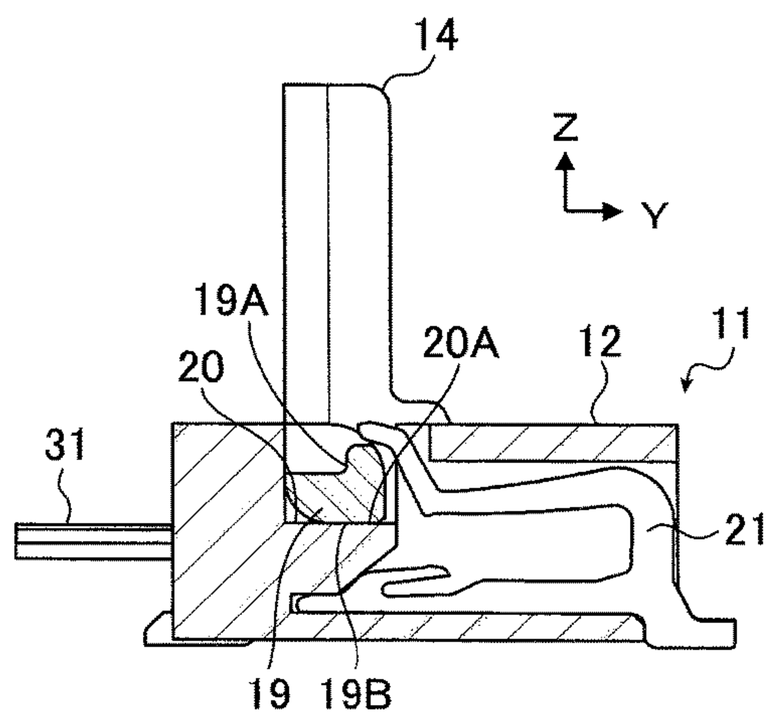


FIG. 11A

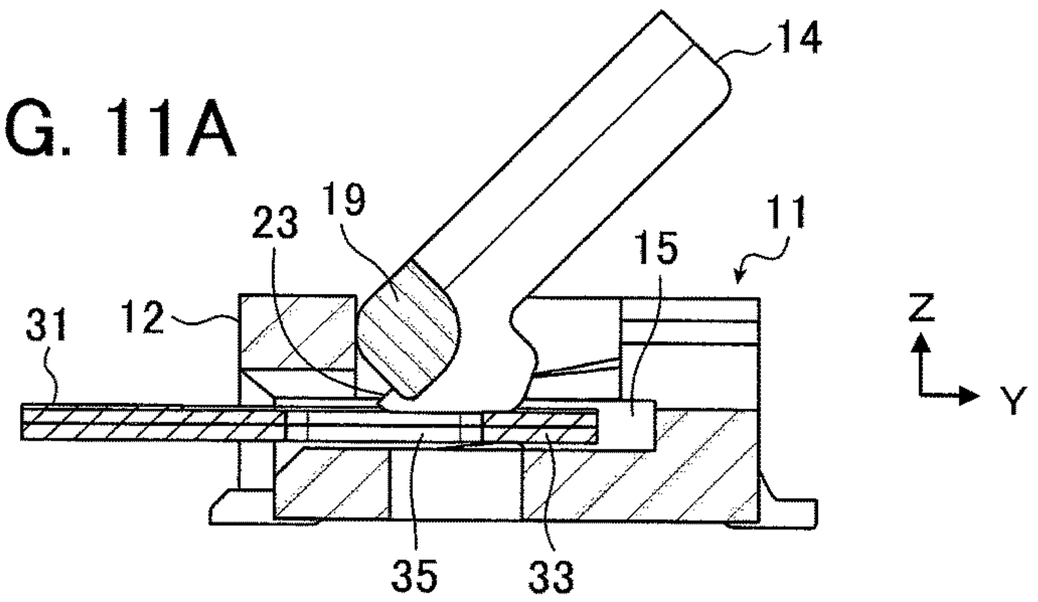


FIG. 11B

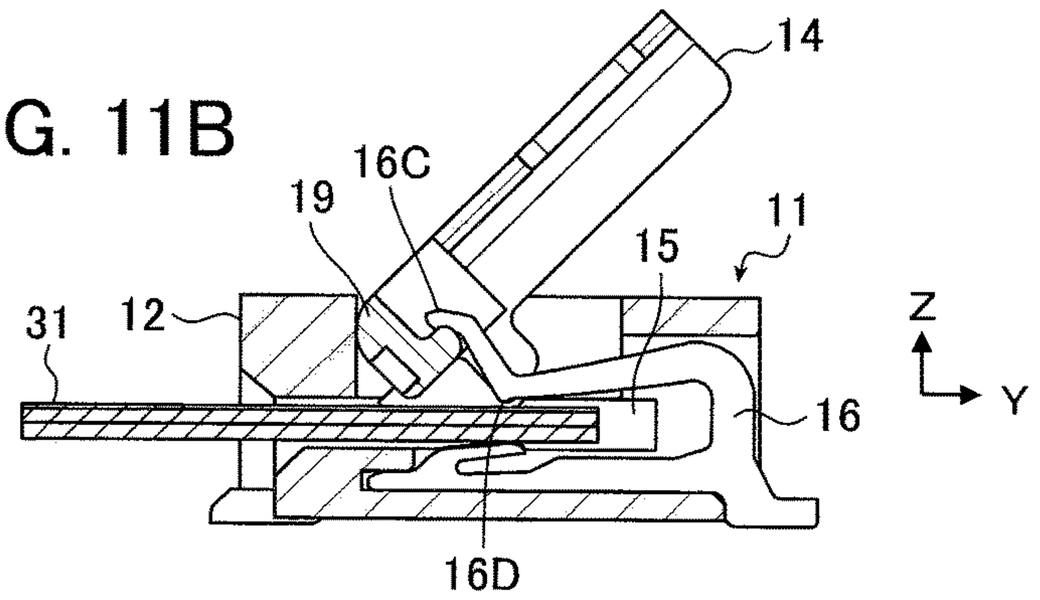


FIG. 11C

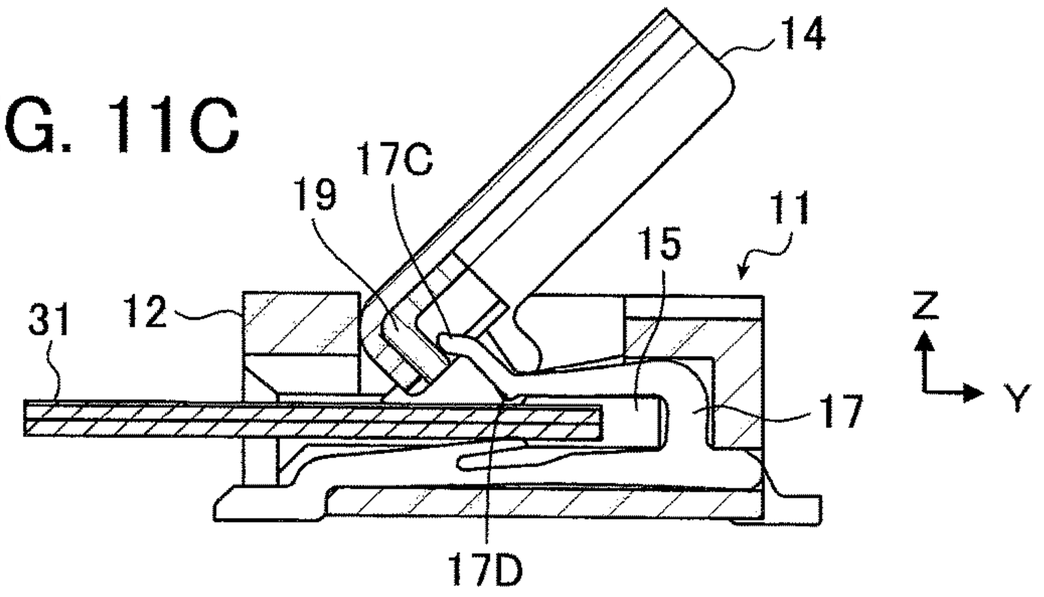


FIG. 11D

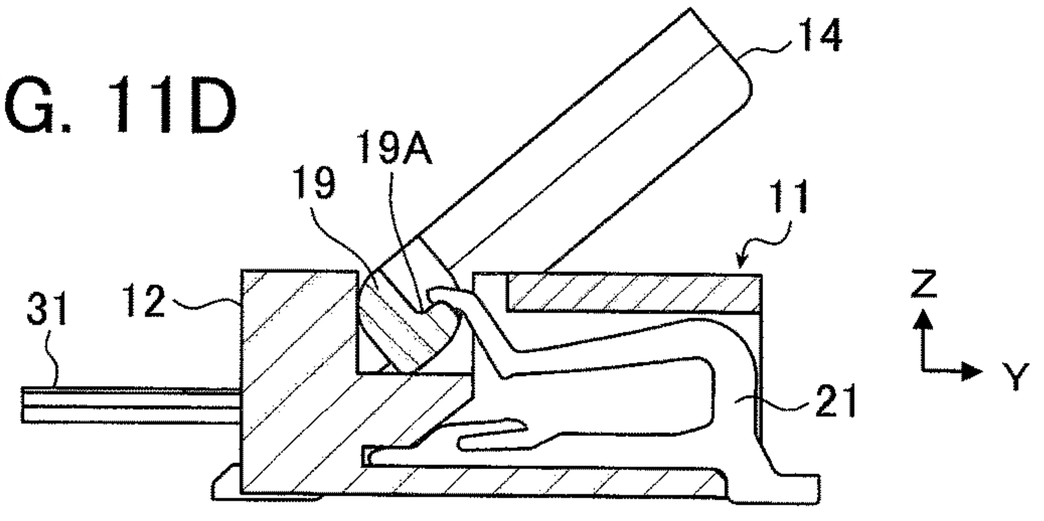


FIG. 12

PRIOR ART

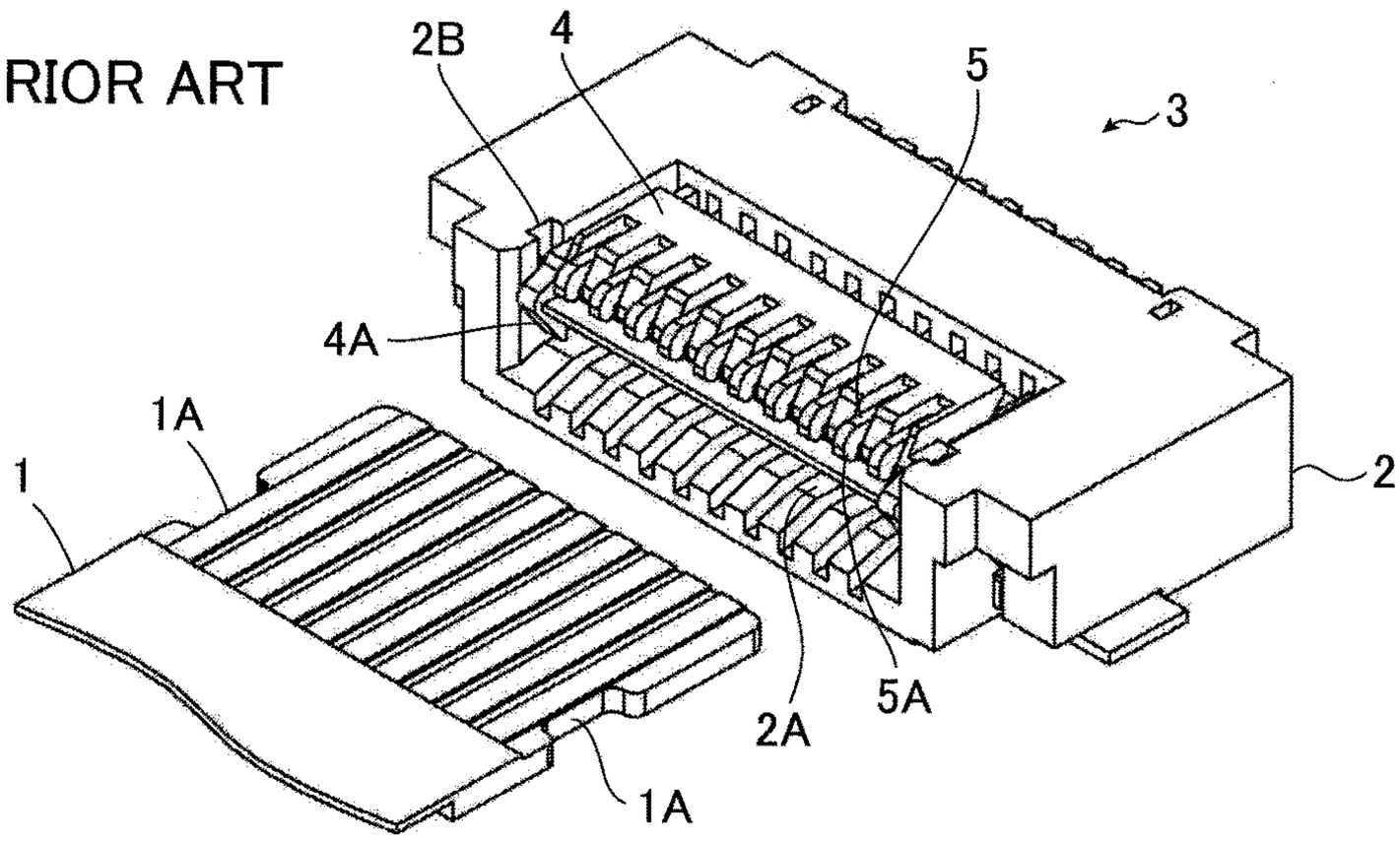


FIG. 13A PRIOR ART

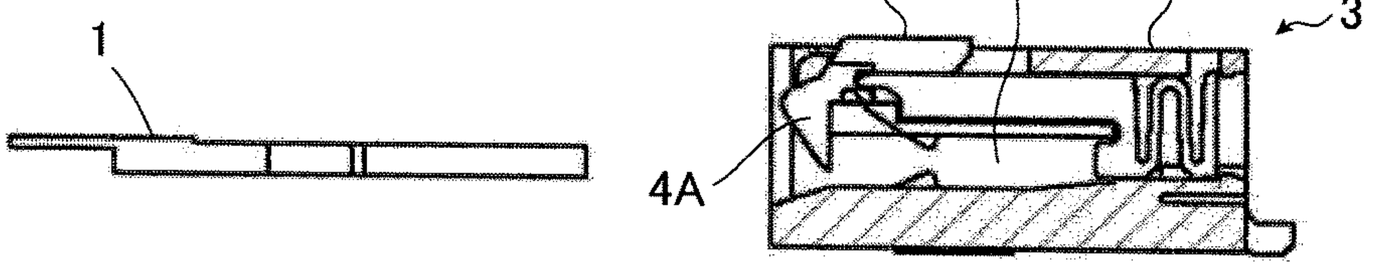


FIG. 13B PRIOR ART

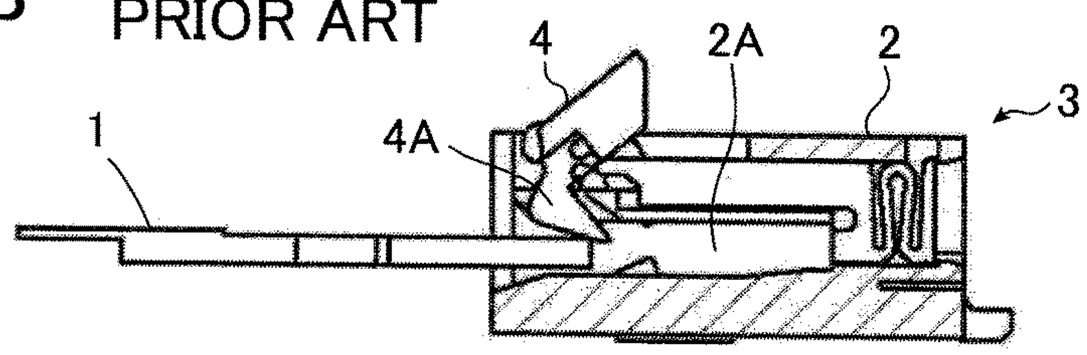
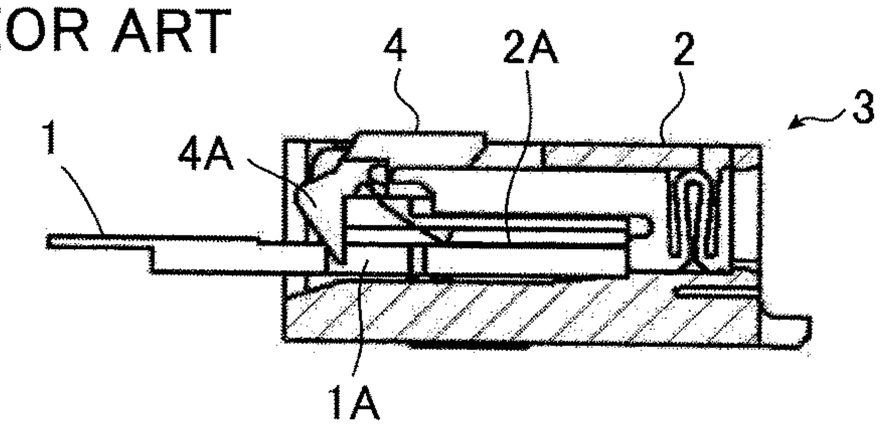


FIG. 13C PRIOR ART



CONNECTOR

BACKGROUND OF THE INVENTION

The present invention relates to a connector, in particular, to a connector that may be connected to connection targets such as a flexible printed circuit (FPC), a flexible flat cable (FFC), a rigid circuit board and other printed wiring boards, the connection targets each comprising a sheet-like base on a surface of which a conductor pattern is disposed.

The FPC here refers to one in which conductive foil (mostly copper foil) is stuck to a flexible film-like insulator base (mostly polyimide), and the conductive foil is subjected to etching by means of lithographic technique to form wiring. The FFC refers to a cable in which flat-shaped conductors are disposed in an alignment and are covered by a sheet-like insulator. The rigid circuit board refers to one in which conductive foil (mostly copper foil) is stuck to a rigid insulator base (mostly glass epoxy), and the conductive foil is subjected to etching by means of lithographic technique to form wiring. Other printed wiring boards each refer to one in which a flexible film-like insulator base or rigid insulator base is provided with wiring through screen printing using a conductive ink.

As a connector of this type to be connected to a connection target, for example, JP 2013-196784A discloses a connector **3** that can be fitted with a connection target **1** by only a single action of inserting the connection target **1** into an insertion portion **2**A of a housing **2**, as illustrated in FIG. **12**.

The housing **2** of the connector **3** is provided with an operation member **4**. A rotation shaft portion that is formed so as to project from both ends of the operation member **4** is inserted in guide recess portions **2**B formed in the housing **2** while holding portions **5**A of contacts **5** are hooked on the operation member **4**, whereby the operation member **4** is held by the housing **2** rotatably around the rotation shaft portion.

As illustrated in FIG. **13**A, each actuation portion **4**A that is integrally formed with the operation member **4** partially projects inside the insertion portion **2**A of the housing **2**. Accordingly, when the connection target **1** is inserted into the insertion portion **2**A, the tip portion of the connection target **1** comes into contact with the actuation portion **4**A of the operation member **4** and pushes the actuation portion **4**A in the insertion direction of the connection target **1**, whereby the operation member **4** rotates, as illustrated in FIG. **13**B.

When the connection target **1** is further inserted into the insertion portion **2**A while the operation member **4** has rotated in this manner, and each cutout **1**A provided in the connection target **1** is located beneath the actuation portion **4**A of the operation member **4**, as illustrated in FIG. **13**C, the operation member **4** that has rotated receives restoring force from the holding portions **5**A of the contacts **5** and returns to the original position shown in FIG. **13**A, whereby fitting between the connector and the connection target **1** is established. In this process, the actuation portion **4**A of the operation member **4** is inserted into the cutout **1**A of the connection target **1**, resulting in prevention of the connection target **1** from falling off the connector **3**.

However, as illustrated in FIG. **13**C, even with the actuation portion **4**A of the operation member **4** being inserted into the cutout **1**A of the connection target **1**, if the connection target **1** is applied with a large withdrawal force that pulls the connection target **1** out from the connector **3**, the

cutout **1**A of the connection target **1** would generate a pushing force to push the actuation portion **4**A of the operation member **4** upward.

Since the guide recess portions **2**B of the housing **2** open upward as shown in FIG. **12**, the pushing force applied to the actuation portion **4**A pushes the operation member **4** upward, causing not only the connection target **1** to be pulled out from the connector **3** but also the operation member **4** to possibly come off the housing **2** upward. If the operation member **4** comes off the housing **2**, the contacts **5** hooked on the operation member **4** may deform beyond their elastic region, and the connector **3** may be damaged and become no longer usable.

SUMMARY OF THE INVENTION

The present invention has been made in order to solve the conventional problem described above and an object of the present invention is to provide a connector capable of maintaining connection with a connection target even if a withdrawal force is applied to the fitted connection target.

A connector according to the present invention comprises:

a housing including an insertion portion into which a connection end portion of a connection target is inserted, a shaft receiving portion having a recess-like shape and opening in an opening direction which crosses an insertion direction of the connection target and an abutment surface facing in an opposite direction from the opening direction of the shaft receiving portion, and

an operation member including a rotation shaft portion to be inserted in the shaft receiving portion and being held by the housing rotatably around an axis direction of the rotation shaft portion,

wherein the operation member includes a lock portion projecting in an orthogonal direction to the axis direction of the rotation shaft portion and a projection projecting in another orthogonal direction to the axis direction of the rotation shaft portion than the orthogonal direction in which the lock portion projects,

wherein the connection end portion of the connection target is allowed to be inserted into or pulled out from the insertion portion when the operation member is located at an open position, and

wherein, as the operation member is brought to a closed position while the connection end portion of the connection target is inserted in the insertion portion, the lock portion is fitted in a lock receiving portion of the connection target to prohibit pull-out of the connection end portion of the connection target from the insertion portion, and the projection comes into contact with or in vicinity of the abutment surface to prohibit movement of the operation member in the opening direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing a connector according to an embodiment of the present invention when viewed obliquely from the front.

FIG. **2** is a perspective view showing the connector according to the embodiment when viewed obliquely from the rear.

FIG. **3**A is a perspective view showing a first contact used in the connector according to the embodiment, and FIG. **3**B is a perspective view showing a second contact used in the connector according to the embodiment.

FIG. **4** is a perspective view showing an operation member used in the connector according to the embodiment.

FIG. **5** is a lateral view of the operation member.

FIG. **6** is a perspective view showing a connection target.

FIGS. **7**A to **7**D are a lateral cross-sectional view taken along a lock portion, a lateral cross-sectional view taken along the first contact, a lateral cross-sectional view taken along the second contact, and a lateral cross-sectional view taken along a torque member, respectively, each showing the connector according to the embodiment prior to fitting with the connection target.

FIGS. **8**A to **8**D are a lateral cross-sectional view taken along the lock portion, a lateral cross-sectional view taken along the first contact, a lateral cross-sectional view taken along the second contact, and a lateral cross-sectional view taken along the torque member, respectively, each showing the connector according to the embodiment in the process of fitting with the connection target.

FIGS. **9**A to **9**D are a lateral cross-sectional view taken along the lock portion, a lateral cross-sectional view taken along the first contact, a lateral cross-sectional view taken along the second contact, and a lateral cross-sectional view taken along the torque member, respectively, each showing the connector according to the embodiment at the completion of fitting with the connection target.

FIGS. **10**A to **10**D are a lateral cross-sectional view taken along the lock portion, a lateral cross-sectional view taken along the first contact, a lateral cross-sectional view taken along the second contact, and a lateral cross-sectional view taken along the torque member, respectively, each showing the connector according to the embodiment when pull-out of the connection target starts.

FIGS. **11**A to **11**D are a lateral cross-sectional view taken along the lock portion, a lateral cross-sectional view taken along the first contact, a lateral cross-sectional view taken along the second contact, and a lateral cross-sectional view taken along the torque member, respectively, each showing the connector according to the embodiment in the process of pull-out of the connection target.

FIG. **12** is a perspective view showing a conventional connector.

FIG. **13**A to **13**C are lateral cross-sectional views showing in a stepwise fashion the conventional connector with which a connection target is to be fitted.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present invention will be described below based on the appended drawings.

FIGS. **1** and **2** show the structure of a connector **11** according to the embodiment. The connector **11** is a small connector for connection with connection targets such as a flexible printed circuit (FPC), a flexible flat cable (FFC), a rigid circuit board, and other printed wiring boards, the connection targets each having a sheet-like base on a surface of which a conductive pattern is disposed. The connector **11** includes a housing **12** having a substantially cuboid outer shape elongated in the width direction, a plurality of contacts **13** arranged in the width direction of the housing **12** and extending from the front surface **12**A side of the housing **12** toward the rear surface **12**B side, and an operation member **14** attached to the housing **12**.

The housing **12** is provided with a recess-like insertion portion **15**, and an insertion opening **15**A of the insertion portion **15** opens toward the front surface **12**A side of the housing **12**. The connector is designed such that a connection target (not shown) is inserted into the insertion portion **15** through the insertion opening **15**A of the insertion portion **15**.

The plurality of contacts **13** are composed of first contacts **16** and second contacts **17** that are alternately arranged, each of the first contacts **16** being partially exposed on the rear surface **12**B side of the housing **12**, and each of the second contacts **17** being partially exposed on the front surface **12**A side of the housing **12**.

For convenience, the direction in which the contacts **13** are arranged is referred to as X direction, the direction from the front surface **12**A side toward the rear surface **12**B side of the housing **12** as +Y direction, and the direction from the bottom toward the top of the housing **12** as +Z direction.

The operation member **14** includes a substantially rectangular plate-like manipulation portion **18** that can cover the upper part of the housing **12** and a rotation shaft portion **19** formed integrally with the manipulation portion **18**. The rotation shaft portion **19** is connected to the end part of the manipulation portion **18** in the −Y direction and extends in the X direction. Both ends of the rotation shaft portion **19** in the X direction project from the manipulation portion **18** in the +X direction and the −X direction, respectively, and are inserted in a pair of recess-like shaft receiving portions **20** formed in the housing **12**. Each of the pair of shaft receiving portions **20** opens in the X direction and the +Z direction. As the operation member **14** is moved from the +Z direction to the −Z direction, both ends of the rotation shaft portion **19** can be inserted in the corresponding shaft receiving portions **20**, respectively. Each of the shaft receiving portions **20** has a flat bottom portion **20**A extending along the XY plane.

The operation member **14** is held in the housing **12** in such a manner that through rotation of both ends of the rotation shaft portion **19** in the pair of shaft receiving portions **20**, the operation member **14** can be rotated within a rotation angle range of substantially 90 degrees from a closed position where the manipulation portion **18** covers the upper part of the housing **12**, via an open position where an end of the manipulation portion **18** on the +Y direction side is apart from the upper part of the housing **12** in the +Z direction, to a fully open position which is farther on the opposite side from the closed position than the open position and in which the manipulation portion **18** stands substantially perpendicularly to the upper part of the housing **12**. FIGS. **1** and **2** illustrate the connector **11** having the operation member **14** located at the closed position.

In addition, a pair of torque members **21** corresponding to the pair of shaft receiving portions **20** are held by the housing **12**. The torque members **21** are in contact with the ends in the X direction of the rotation shaft portion **19** that are inserted in the shaft receiving portions **20** and exert a torque on the operation member **14** for movement from the open position toward the closed position.

As illustrated in FIG. **3**A, the first contact **16** includes an upper arm portion **16**A and a lower arm portion **16**B, the upper and lower arm portions **16**A and **16**B each extending in the Y direction with their ends in the +Y direction connected to each other in the Z direction, and has spring properties. The upper arm portion **16**A is provided at its end in the −Y direction with a tip portion **16**C that comes into contact with the rotation shaft portion **19** of the operation member **14**, and, at a position away from the tip portion **16**C in the +Y direction, provided with a contact portion **16**D that projects in the −Z direction. The lower arm portion **16**B is provided at its end in the +Y direction with a board connection portion **16**E for connection with a connection pad of a board (not shown) on which the connector **11** is to be

mounted and the board connection portion **16**E is exposed from the housing **12** on the rear surface **12**B side.

As illustrated in FIG. **3**B, the second contact **17** includes an upper arm portion **17**A and a lower arm portion **17**B, the upper and lower arm portions **17**A and **17**B each extending in the Y direction with their ends in the +Y direction connected to each other in the Z direction, and has spring properties. The upper arm portion **17**A is provided at its end in the −Y direction with a tip portion **17**C that comes into contact with the rotation shaft portion **19** of the operation member **14**, and, at a position away from the tip portion **17**C in the +Y direction, provided with a contact portion **17**D that projects in the −Z direction. The lower arm portion **17**B is provided at its end in the −Y direction with a board connection portion **17**E for connection with a connection pad of a board (not shown) on which the connector **11** is to be mounted and the board connection portion **17**E is exposed from the housing **12** on the front surface **12**A side.

As illustrated in FIG. **4**, the rotation shaft portion **19** of the operation member **14** is provided at both ends thereof, respectively, with step portions **19**A with which the corresponding torque members **21** come into contact and which face in the +Z direction.

The manipulation portion **18** includes a manipulation portion body **18**A in a flat plate shape and a pair of bent portions **18**B each being bent into a right angle with respect to the manipulation portion body **18**A from the ends of the manipulation portion body **18**A in the +X direction and in the −X direction. The manipulation portion body **18**A is provided with an opening portion **18**C in a substantially rectangular shape extending in the X direction.

As illustrated in FIG. **5**, each of the bent portions **18**B is provided with a lock portion **22** projecting in the −Z direction orthogonal to the X direction that is the axial direction of the rotation shaft portion **19** and a projection **23** projecting in the −Y direction orthogonal to the X direction that is the axial direction of the rotation shaft portion **19** when the operation member **14** is located at the closed position, and the manipulation portion body **18**A is located on the XY plane.

The lock portion **22** has a push-in surface **22**A facing in the −Y direction and in the −Z direction and a lock surface **22**B facing in the +Y direction. When the operation member **14** is located at the closed position, an angle θ**1** between the +Y direction that is the insertion direction of the connection target (not shown) and the push-in surface **22**A is set to have a value smaller than 90 degrees, while an angle θ**2** between the +Y direction and the lock surface **22**B is set to have a value not smaller than 90 degrees.

The projection **23** is disposed adjacent to the lock portion **22** on the −Y direction side.

The manipulation portion **18**, the lock portion **22** and the projection **23** as above are integrally formed as a single metal member and can be formed through the process of punching out and bending a single metal plate. Through the insert-molding using the metal member, the operation member **14** in which the rotation shaft portion **19** is integrated with the metal member can be formed.

The rotation shaft portion **19** is provided at both ends thereof respectively with flat portions **19**B that face in the −Y direction and extend along the XZ plane when the operation member **14** is located at the closed position.

FIG. **6** illustrates a connection target **31** to be fitted with the connector **11**. The connection target **31** is composed of an FPC, for example, and has a structure in which a conductor pattern is formed on a sheet-like insulation base **32**. On a surface of a connection end portion **33** to be connected with the connector **11**, a plurality of electrodes **34** formed of the conductor pattern are arranged in the X direction and exposed. The electrodes **34** are arranged at the same pitch as that of the contacts **13** of the connector **11**.

The connection end portion **33** of the connection target **31** is provided at the both ends thereof respectively with cutouts **35** as the lock receiving portions. The cutouts **35** are disposed at the positions corresponding in the X direction to the lock portions **22** of the operation member **14** when the connection end portion **33** of the connection target **31** is inserted into the insertion portion **15** of the connector **11**.

Next, the operation for fitting the connection target **31** with the connector **11** will be described.

Before fitting with the connection target **31**, as illustrated in FIG. **7**D, the tip portion of the torque member **21** held by the housing **12** applies a force in the −Z direction on the step portion **19**A of the rotation shaft portion **19** of the operation member **14**, whereby the operation member **14** is located at the closed position to cover the upper part of the housing **12** with the manipulation portion body **18**A as illustrated in FIG. **7**A.

At this time, the lock portion **22** of the operation member **14** extends across the insertion portion **15** of the housing **12** in the Z direction, the push-in surface **22**A of the lock portion **22** opposes the insertion opening **15**A of the insertion portion **15**, and the projection **23** is in contact with or in vicinity of a ceiling surface **15**B of the insertion portion **15** of the housing **12**. The ceiling surface **15**B of the insertion portion **15** forms an abutment surface which the projection **23** abuts.

In addition, as illustrated in FIGS. **7**B and **7**C, the tip portion **16**C of the first contact **16** and the tip portion **17**C of the second contact **17** are not in contact with the rotation shaft portion **19** of the operation member **14**, and the contact portion **16**D of the first contact **16** and the contact portion **17**D of the second contact **17** project inside the insertion portion **15**.

As the connection end portion **33** of the connection target **31** is inserted into the insertion portion **15** through the insertion opening **15**A in the +Y direction, as illustrated in FIG. **8**A, the tip end face in the +Y direction of the connection end portion **33** comes into contact with the push-in surface **22**A of the lock portion **22** of the operation member **14** and pushes the push-in surface **22**A in the +Y direction, whereby the operation member **14** starts rotating toward the open position so that the manipulation portion body **18**A moves apart from the upper part of the housing **12**. Here, each of the cutouts **35** of the connection end portion **33** of the connection target **31** is still located away from the lock portion **22** of the operation member **14** on the −Y direction side.

As illustrated in FIG. **8**D, both ends of the rotation shaft portion **19** of the operation member **14** each rotate in the shaft receiving portion **20** of the housing **12**, while the torque members **21** exert a torque on the operation member **14** for returning to the closed position.

At this time, as illustrated in FIGS. **8**B and **8**C, the tip portion **16**C of the first contact **16** and the tip portion **17**C of the second contact **17** are in contact with and are pulled up in the +Z direction by the rotation shaft portion **19** of the operation member **14**, whereby the contact portion **16**D of the first contact **16** and the contact portion **17**D of the second contact **17** are located away in the +Z direction from the insertion portion **15**.

When the operation member **14** is located at the open position as illustrated in FIGS. **8**A to **8**D as described above,

the connection end portion **33** of the connection target **31** is allowed to be inserted into the insertion potion **15**.

Then, as the connection end portion **33** of the connection target **31** is further inserted in the +Y direction, each of the cutouts **35** of the connection target **31** reaches the lock portion **22** of the operation member **14**, causing the torque member **21** to exert a torque on the rotation shaft portion **19** of the operation member **14**. Hence, as illustrated in FIG. **9**A, the operation member **14** rotates in the opposite direction to the preceding rotation to return to the closed position. Accordingly, the lock portion **22** of the operation member **14** is fitted in the cutout **35** of the connection end portion **33** of the connection target **31**.

Since the operation member **14** returns to the closed position, as illustrated in FIG. **9**D, the torque member **21** is brought back to the state before fitting with the connection target **31**.

In this process, as illustrated in FIGS. **9**B and **9**C, the rotation shaft portion **19** of the operation member **14** is separated from the tip portion **16**C of the first contact **16** and the tip portion **17**C of the second contact **17**, while, due to the spring properties of the first and second contacts **16** and **17**, the contact portion **16**D of the first contact **16** and the contact portion **17**D of the second contact **17** are pressed against the corresponding electrode **34** of the connection end portion **33** of the connection target **31** that is inserted into the insertion portion **15**, thereby establishing electrical connection.

As above, with the operation member **14** being located at the closed position, the fitting operation of the connection target **31** with the connector **11** can be completed only by a single action of inserting the connection end portion **33** of the connection target **31** into the insertion portion **15** through the insertion opening **15**A.

At this time, since the lock portions **22** of the operation member **14** are fitted in the cutouts **35** of the connection end portion **33** of the connection target **31**, even if the connection end portion **33** of the connection target **31** is pulled out from the insertion portion **15**, the cutouts **35** would be hooked on the lock surfaces **22**B of the lock portions **22**, prohibiting the pull-out of the connection target **31**.

Assuming that the connection target **31** is applied with the even stronger withdrawal force to forcibly pull the connection target **31** out the connector **11**, the cutouts **35** of the connection target **31** would possibly generate a force to push the lock portions **22** of the operation member **14** up in the +Z direction since the angle θ**2** between the +Y direction that is the insertion direction of the connection target **31** and each of the lock surfaces **22**B is set to have a value not smaller than 90 degrees. Since both ends of the rotation shaft portion **19** of the operation member **14** are inserted in the shaft receiving portions **20** opening in the +Z direction, movement of the operation member **14** in the +Z direction cannot be prohibited by the shaft receiving portions **20** of the housing **12**.

However, when the operation member **14** is located at the closed position, the projections **23** of the operation member **14** are in contact with or in vicinity of the ceiling surface **15**B of the insertion portion **15** of the housing **12**. Hence, even if the lock portions **22** are applied with a pushing force up in the +Z direction, the projections **23** abut and are caught by the ceiling surface **15**B of the insertion portion **15** of the housing **12** so that movement of the operation member **14** in the +Z direction can be prohibited. If the projections **23** are in contact with the ceiling surface **15**B of the insertion portion **15** when the operation member **14** is located at the closed position, the operation member **14** does not move in the +Z direction. Even if the projections **23** are in vicinity of the ceiling surface **15**B of the insertion portion **15** when the operation member **14** is located at the closed position, the operation member **14** slightly moves until the projections **23** come into contact with the ceiling surface **15**B of the insertion portion **15**, and then its movement in the +Z direction will be prohibited.

Therefore, even if the connection target **31** fitted with the connector **11** is applied with a withdrawal force, the connection target **31** is prevented from being pulled out, and the connector **11** can be prevented from being damaged due to the movement of the operation member **14** in the +Z direction, thereby enabling to maintain connection with the connection target **31**.

Subsequently, an operation to pull out the connection target **31** fitted with the connector **11** from the connector **11** will be described.

First, when the connection target **31** is pulled out, as illustrated in FIG. **10**A, the operation member **14** is rotated to the fully open position that is farther in the opposite direction from the closed position than the open position as illustrated in FIGS. **8**A to **8**D. That is, the operation member **14** is rotated until the manipulation portion body **18**A comes on the XZ plane and abuts the housing **12**, thereby standing substantially perpendicularly to the upper part of the housing **12**. In this manner, the lock portions **22** of the operation member **14** come off the cutouts **35** of the connection target **31** in the +Z direction, but the projections **23** of the operation member **14** project into the insertion portion **15** of the housing **12** so as to be located inside the cutouts **35** of the connection target **31**.

At this time, as illustrated in FIG. **10**D, the tip portion of each of the torque members **21** comes off the step portion **19**A of the rotation shaft portion **19** of the rotation member **14**, the torque member **21** applies a force of pushing the rotation shaft portion **19** in the −Z direction without causing the rotation shaft portion **19** to generate a torque. In addition, when the operation member **14** is located at the closed position, the flat portions **19**B of the rotation shaft portion **19** each face in the −Y direction and extend along the XZ plane, whereas, if the operation member **14** is rotated to the fully open position, the flat portions **19**B of the rotation shaft portion **19** each face in the −Z direction and extend along the XY plane.

Accordingly, the flat portions **19**B of the rotation shaft portion **19** are located on the flat bottom portions **20**A of the shaft receiving portions **20**, and the operation member **14** is maintained stably at the fully open position.

At this time, as illustrated in FIGS. **10**B and **10**C, the tip portion **16**C of the first contact **16** and the tip portion **17**C of the second contact **17** come into contact with and are pulled up in the +Z direction by the rotation shaft portion **19** of the operation member **14**, whereby the contact portion **16**D of the first contact **16** and the contact portion **17**D of the second contact **17** are away in the +Z direction from the insertion portion **15**.

If the connection target **31** is pulled out from the connector **11** in this state, the cutouts **35** of the connection target **31** are hooked on the projections **23** of the operation member **14**, whereby the operation member **14** rotates toward the closed position as illustrated in FIG. **11**A. The operation member **14** is rotated until the projections **23** of the operation member **14** exit from the insertion portion **15** in the +Z direction, whereby the connection end portion **33** of the connection target **31** can be pulled out from the insertion portion **15**.

In this state, as illustrated in FIG. **11**D, the torque member **21** exerts a torque on the rotation shaft portion **19** of the operation member **14** for returning the operation member **14** to the closed position.

As illustrated in FIGS. **11**B and **11**C, the tip portion **16**C of the first contact **16** and the tip portion **17**C of the second contact **17** are maintained as being pulled up in the +Z direction by the rotation shaft portion **19** of the operation member **14**.

When the connection end portion **33** of the connection target **31** is thoroughly pulled out from the insertion portion **15**, due to the torque exerted on the step portion **19**A of the rotation shaft portion **19** by the torque member **21**, the operation member **14** rotates to the closed position, and the connector **11** returns to the state as illustrated in FIGS. **7**A to **7**D.

As illustrated in FIG. **10**A, the operation member **14** cannot be opened wider than the fully open position where the manipulation portion body **18**A is located on the XZ plane and abuts the housing **12**, and when the operation member **14** is located at the fully open position, the projections **23** project inside the insertion portion **15** of the housing **12**. Hence, for fitting the connection target **31** with the connector **11**, even if the connection target **31** is to be inserted into the insertion portion **15** with the operation member **14** being wrongly located at the fully open position, the tip end of the connection end portion **33** of the connection target **31** abuts the projections **23** projecting inside the insertion portion **15**, thereby preventing the connection target **31** from being inserted.

Accordingly, when the operation member **14** is located at the fully open position, wrong insertion of the connection target **31** can be avoided, ensuring the fitting operation by a single action in the state where the operation member **14** is located at the closed position.

In addition, as illustrated in FIG. **4**, the manipulation portion **18** of the operation member **14** is provided with the opening portion **18**C, and when the operation member **14** is brought to the closed position, as illustrated in FIGS. **1** and **2**, an outer face **12**C, facing in the +Z direction, of the housing **12** is exposed through the opening portion **18**C. Thus, the outer face **12**C of the housing **12** through the opening portion **18**C can be used as a suction face to enable handling of the connector **11**. By directly performing suction on the housing **12** instead of performing suction on the operation member **14** that is a movable member, stable handling can be achieved.

In the embodiment described above, the ceiling surface **15**B of the insertion portion **15** forms an abutment surface, and the projections **23** abut the ceiling surface **15**B of the insertion portion **15**, whereby movement of the operation member **14** in the +Z direction is prohibited. However, even if an abutment surface is provided somewhere else on the housing **12** other than the ceiling surface **15**B of the insertion portion **15**, movement of the operation member **14** in the +Z direction can be similarly prohibited.

Moreover, in the embodiment described above, the operation member **14** includes the manipulation portion **18**, and when the connection target **31** is pulled out from the connector **11**, the operation member **14** can be rotated to the fully open position by lifting the manipulation portion **18**. However, the manipulation portion **18** can be omitted from the operation member **14**. In such case, it is necessary that the connection target **31** be pulled out from the connector **11** after the operation member **14** is rotated to the fully open position by means of a jig or like.

Furthermore, in the embodiment described above, the torque members **21** held by the housing **12** come into contact with the rotation shaft portion **19** to exert a torque on the operation member **14** such that the operation member **14** rotates from the open position to the closed position, whereby the connection target **31** is fitted with the connector **11** only by a single action of inserting the connection end portion **33** of the connection target **31** into the insertion portion **15**. However, this is not the sole case. For example, instead of using the torque members **21**, the manipulation portion **18** may be manipulated so that the operation member **14** is brought to the open position as illustrated in FIGS. **8**A to **8**D to insert the connection end portion **33** of the connection target **31** into the insertion portion **15**, and subsequently the manipulation portion **18** may be manipulated so that the operation member **14** is brought to the closed position as illustrated in FIGS. **9**A to **9**D.

Even in this manner, the lock portions **22** are fitted in the cutouts **35** of the connection target **31** so that pull-out of the connection end portion **33** of the connection target **31** from the insertion portion **15** can be prohibited, while movement of the operation member **14** in the +Z direction can be prohibited since the projections **23** come into contact with or in vicinity of the ceiling surface **15**B of the insertion portion **15**.

In the case where the operation member **14** is rotated by not using the torque members **21** but manipulating the manipulation portion **18**, when the operation member **14** is located at the closed position, the manipulation portion **18** is not required to extend in the insertion direction of the connection target **31**, i.e., in the +Y direction, from the rotation shaft portion **19** and may extend in the pull-out direction of the connection target **31**, i.e., in the −Y direction.

In the connector **11** according to the embodiment above, the first contacts **16** and the second contacts **17** are alternately arranged in the X direction. However, this is not the sole case, and contacts of only a single type can be arranged.

In addition, the number of contacts **13** in the connector **11** is not particularly limited as long as the number of contacts **13** corresponds to the number of electrodes **34** of the connection end portion **33** of the connection target **31**.

In the embodiment described above, a plurality of electrodes **34** are formed and arranged on only the front surface, among the front and back surfaces, of the connection end portion **33** of the connection target **31**. However, the electrodes **34** may be formed and arranged on each of the front and back surfaces of the connection end portion **33**.

The connection target **31** is provided with the cutouts **35** as the lock receiving portions in which the lock portions **22** are fitted when fitting with the connector **11**. However, lock receiving portions are not particularly limited to the cutouts **35**, and through holes formed in the connection target **31**, for example, can be used as the lock receiving portions.

The connection target **31** is not particularly limited to an FPC, and various connection targets including an FFC, a rigid circuit board or other printed wiring boards can be used.

What is claimed is:

1. A connector into which a connection end portion of a connection target that is provided with a lock receiving portion is inserted, comprising:

a housing including an insertion portion into which the connection end portion of the connection target is inserted, a shaft receiving portion having a recess-like shape and opening in an opening direction which crosses an insertion direction of the connection target

and an abutment surface facing in an opposite direction from the opening direction of the shaft receiving portion, and

an operation member including a rotation shaft portion to be inserted in the shaft receiving portion and being held by the housing rotatably around an axis direction of the rotation shaft portion,

wherein the operation member includes a lock portion projecting in an orthogonal direction to the axis direction of the rotation shaft portion and a projection projecting in another orthogonal direction to the axis direction of the rotation shaft portion than the orthogonal direction in which the lock portion projects,

wherein the connection end portion of the connection target is allowed to be inserted into or pulled out from the insertion portion when the operation member is located at an open position, and

wherein, as the operation member is brought to a closed position while the connection end portion of the connection target is inserted in the insertion portion, the lock portion is fitted in the lock receiving portion of the connection target to prohibit pull-out of the connection end portion of the connection target from the insertion portion, and the projection comes into contact with or in vicinity of the abutment surface to prohibit movement of the operation member in the opening direction.

2. The connector according to claim **1**, wherein the abutment surface is constituted of a ceiling surface of the insertion portion.

3. The connector according to claim **1**, wherein the lock portion includes: a push-in surface opposing an insertion opening of the insertion portion when the operation member is located at the closed position; and a lock surface facing on an opposite side from the insertion opening of the insertion portion when the operation member is located at the closed position, and

wherein, as the connection end portion of the connection target is inserted into the insertion portion while the operation member is located at the closed position, a tip end face of the connection end portion of the connection target comes into contact with the push-in surface and pushes the push-in surface in the insertion direction of the connection target to rotate the operation member toward the open position, and the lock portion is fitted in the lock receiving portion of the connection target, causing the operation member to return to the closed position to prohibit the pull-out of the connection end portion of the connection target from the insertion portion by the lock surface.

4. The connector according to claim **3**, wherein, when the operation member is located at the closed position, an angle between the push-in surface and the insertion direction of the connection target is less than 90 degrees, and an angle between the lock surface and the insertion direction of the connection target is not smaller than 90 degrees.

5. The connector according to claim **3**, further comprising a torque member held by the housing and exerting a torque on the operation member such that the operation member rotates from the open position toward the closed position.

6. The connector according to claim **1**, wherein the lock portion and the projection are integrated as a single metal component.

7. The connector according to claim **1**, wherein the operation member includes a manipulation portion extending in the insertion direction of the connection target when the operation member is located at the closed position.

8. The connector according to claim **7**, wherein the manipulation portion includes an opening portion, and when the operation member is located at the closed position, an outer face of the housing exposed through the opening portion forms a suction face to perform suction of the connector.

9. The connector according to claim **1**,

wherein the operation member is held by the housing so as to be rotatable to a fully open position that is farther opposite from the closed position than the open position, and

wherein, when the operation member is located at the fully open position, a part of the projection projects inside the insertion portion so as to prohibit insertion of the connection end portion of the connection target into the insertion portion.

10. The connector according to claim **9**,

wherein the shaft receiving portion includes a bottom portion that is flat and extends in the insertion direction of the connection target, and

wherein the rotation shaft portion includes a flat portion that comes into contact with the bottom portion of the shaft receiving portion when the operation member is located at the fully open position.

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